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1 WHAT IS CLAIMED IS:

- 1 1. A process for applying a paint coat, suitable
for exterior automotive use, to a plastic exterior body
panel of a motor vehicle, characterized by the steps of:
- 5 applying a clear coat (45) of a synthetic
resinous material in thin film form onto a surface of a
flexible casting sheet (42), and drying the clear coat
on the casting sheet, the surface of the sheet having a
specular reflectance for transferring to the surface of
10 the dried clear coat a gloss level sufficient for
exterior automotive use;
- forming a color coat (46) of a pigmented
synthetic resinous material which is dried and adhered
to the clear coat;
- 15 transferring the dried clear coat and color
coat to a semirigid backing sheet (72) of a synthetic
resinous material to form a composite paint coat (44)
bonded to a face of the backing sheet, in which the
clear coat forms the exterior surface of the transferred
20 paint coat and the color coat is bonded between the
clear coat and the face of the backing sheet, and in
which the exterior surface of the clear coat
substantially retains the gloss transferred to it from
its casting sheet;
- 25 thermoforming the backing sheet and the
composite paint coat thereon to form a three-
dimensionally shaped preformed laminate (116); and
- placing the preformed laminate in a mold and
molding a synthetic resinous substrate material (118) to
30 the preformed laminate to form an exterior vehicle body
panel (130) with a finished exterior automotive paint
coat;
- the clear coat comprising a material that
substantially retains said gloss level during the
35 thermoforming step; the backing sheet having sufficient

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1 thickness and sufficient elongation to absorb defects
present in the substrate material to retain an
essentially defect-free gloss on the clear coat surface
5 following adherence of the laminate to the substrate
material; the finished composite paint coat providing
sufficient appearance and durability properties for use
as an exterior automotive paint coat.

10 2. The process according to claim 1,
characterized in that the laminate (116) is thermoformed
at a temperature greater than about 270°F, and the
composite paint coat (44) elongates greater than about
40% during the thermoforming step while still retaining
15 said gloss level and said exterior automotive appearance
and durability properties.

20 3. The process according to claim 1,
characterized in that the clear coat (45) comprises a
fluorinated polymer and acrylic resin-containing
material.

25 4. The process according to claim 3,
characterized in that the clear coat (45) comprises a
thermoplastic paint system in which the fluorinated
polymer is selected from the group consisting of
polyvinylidene fluoride, and copolymers and terpolymers
of vinylidene fluoride.

30 5. The process according to claim 4,
characterized in that the dried clear coat (45) contains
less than about 70% polyvinylidene fluoride and less
than about 50% acrylic resin, by weight of the total
acrylic resin and PVDF solids present in the clear coat.

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1 6. The process according to claim 1,
characterized in that the paint coat (44) has the
minimum levels of gloss, distinctiveness-of-image, QUV,
gasoline resistance, cleanability, acid resistance,
5 hardness, abrasion resistance and impact strength,
substantially as defined in the automotive
specifications for exterior automotive paint finishes
described herein.

10 7. The process according to claim 1,
characterized in that the preformed laminate (116) is
molded to the substrate material (118) by injection
cladding, reaction injection molding, or thermoset sheet
molding techniques.

15 8. The process according to claim 1,
characterized in that the clear coat (45) applied to the
casting sheet (42) comprises a thermoplastic paint
system which includes polyvinylidene fluoride and an
20 acrylic resin, in which the polyvinylidene fluoride is
dispersed in a solution of the acrylic resin.

25 9. The process according to claim 1,
characterized in that the clear coat (45) applied to the
casting sheet (42) comprises a thermoplastic paint
system comprising a solution of polyvinylidene fluoride
and acrylic resin.

30 10. The process according to claim 9,
characterized in that the finished paint coat (44) has a
60° gloss level greater than about 75 gloss units and a
distinctiveness-of-image level greater than about 80
units.

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1 11. The process according to claim 1,
characterized in that the backing sheet (72) is a
semirigid sheet with a thickness in the range from about
10 mils to about 40 mils.

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 12. The process according to claim 1,
characterized in that the backing sheet (72) is made
from a material selected from the group consisting of
ABS, polyester, amorphous nylon, and thermoplastic
10 polyolefins, including polypropylene and polyethylene.

 13. The process according to claim 1,
characterized by including applying a thin film of wax
to the casting sheet (42) prior to casting the clear
15 coat (45) on the casting sheet.

 14. The process according to claim 1,
characterized in that a graphics pattern is printed
between the clear coat (45) and the color coat (46).

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 15. The process according to claim 1,
characterized by a pigment contained in the backing
sheet (72).

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 16. The process according to claim 1,
characterized by metallic flakes contained in the color
coat (46), in which the flakes are aligned linearly when
coated on a carrier film.

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 17. The process according to claim 1,
characterized in that a water soluble protective coating
on the exterior surface of the paint coat (44).

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1 18. The process according to claim 17,
characterized by the protective coating is over stamped
on the clear coat (45).

5 19. The process according to claim 1,
characterized in that the thermoforming step is carried
out by avoiding contact between the thermoforming
apparatus (112) and the clear coat (45) side of the
backing sheet (72).

10 20. A thermoformable laminate for use in forming
an exterior portion of an exterior car body panel, the
laminate comprising a thin, semirigid backing sheet made
from a synthetic resinous material, and an automotive
15 quality paint coat bonded to a face of the backing
sheet, in which the paint coat includes a synthetic
resinous coating in dry thin film form having an
exterior surface with a predetermined gloss level
transferred to it from a high gloss casting sheet, the
20 paint coat having sufficient elongation and resistance
to deglossing such that the laminate is thermoformable
into a highly contoured three-dimensional shape while
the paint coat substantially retains said predetermined
gloss level during thermoforming and provides
25 predetermined appearance and durability properties
sufficient to be useful as an exterior automotive paint
coat following thermoforming of the laminate.

30 21. The article according to claim 20 in which the
laminate can be thermoformed at a temperature of at
least about 270°F, and the paint coat elongates greater
than about 40% during thermoforming at said
thermoforming temperature while still retaining said
gloss level and said appearance and durability
35 properties.

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22. The article according to claim 20 in which the paint coat comprises a fluorinated polymer and acrylic resin-containing paint system with thermoplastic properties, in which the paint coat has been coated on a casting sheet and dried and then transferred from the casting sheet to the backing sheet.

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23. The article according to claim 20 in which the paint coat comprises a thermoplastic paint system which includes polyvinylidene fluoride and an acrylic resin.

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24. The article according to claim 23 in which the dried paint coat contains less than about 70% polyvinylidene fluoride and less than about 50% acrylic resin, by weight of the total PVDF and acrylic resin components contained in the paint coat.

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25. The article according to claim 20 in which the paint coat comprises a pigmented synthetic resinous material with thermoplastic properties.

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26. The article according to claim 20 in which the paint coat comprises an exterior clear coat and an underlying color coat bonded to the clear coat.

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27. The article according to claim 26 in which the color coat contains a highly dispersed pigment, and in which the clear coat comprises a thermoplastic coating principally containing a fluorinated polymer and an acrylic resin.

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1 28. The article according to claim 27 in which the
clear coat is a thermoplastic paint system which
consists essentially of about 50% to about 70%
polyvinylidene fluoride and about 30% to about 50%
5 acrylic resin; and in which the acrylic resin component
comprises polymethyl methacrylate, polyethyl
methacrylate, or mixtures thereof, including copolymers
thereof.

10 29. The article according to claim 28 in which the
color coat also consists essentially of about 50% to
about 70% polyvinylidene fluoride and about 30% to about
50% acrylic resin; and in which the acrylic resin
component comprises polymethyl methacrylate, polyethyl
15 methacrylate, or mixtures thereof, including copolymers
thereof.

20 30. The article according to claim 20 in which the
paint coat on the thermoformed laminate has at least the
minimum levels of gloss, distinctiveness-of-image, QUV,
hardness, impact resistance, cleanability, acid
resistance, gasoline resistance, and abrasion
resistance, substantially as defined in the automotive
specifications for exterior automotive paint finishes
25 described herein.

31. The article according to claim 20 in which the
paint coat includes a fluorinated polymer selected from
the group consisting of polyvinylidene fluoride, and
30 copolymers and terpolymers of vinylidene fluoride.

32. The article according to claim 20 in which the
paint coat has a 60° gloss level greater than about 75
gloss units and a distinctiveness-of-image level greater
35 than about 80 units.

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33. The article according to claim 20 in which the backing sheet is a semirigid sheet with a thickness in the range from about 10 mils to about 40 mils.

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34. The article according to claim 20 in which the backing sheet is made from a material selected from the group consisting of ABS, polyester, amorphous nylon, thermoplastic polyolefins, including polypropylene and polyethylene.

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35. The article according to claim 20 including a wax film applied to the outer face of the clear coat from the casting sheet.

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36. The article according to claim 20 in which a graphics pattern is printed between the paint coat and backing sheet and is visible through the paint coat.

37. The article according to claim 20 including a pigment contained in the backing sheet.

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38. The article according to claim 20 including a metallic flake paint layer contained in the paint coat.

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39. The article according to claim 20 including a water soluble protective coating on the exterior surface of the paint coat.

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40. An exterior plastic body panel for motor vehicles, the panel having a synthetic resinous automotive quality paint coat bonded to a synthetic resinous thermoformable backing sheet to form a laminate in which the exterior surface of the paint coat has exterior automotive gloss and distinctiveness-of-image

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1 levels, and in which the laminate has been thermoformed
into a three-dimensional shape and adhered to a plastic
substrate to form said plastic exterior body panel, the
paint coat having sufficient elongation and resistance
5 to deglossing to have substantially maintained said
gloss and distinctiveness-of-image levels during
thermoforming, the backing sheet having sufficient
thickness and elongation to have absorbed defects in the
substrate material, thereby providing said paint coat on
10 the finished body panel with an essentially defect-free
surface with the appearance and durability properties
sufficient for exterior automotive use.

41. The panel according to claim 40 in which the
15 paint coat comprises a thermoplastic fluorinated polymer
and acrylic resin-containing paint system.

42. The panel according to claim 40 in which the
finished paint coat has the minimum levels of gloss,
20 distinctiveness-of-image, QUV, gasoline resistance,
cleanability, acid resistance, hardness, abrasion
resistance, and impact strength, substantially as
defined in the automotive specifications for exterior
automotive paint finishes described herein.

43. The panel according to claim 40 in which the
25 paint coat comprises an exterior clear coat and an
underlying color coat bonded to the clear coat.

44. The panel according to claim 43 in which the
30 clear coat comprises a fluorinated polymer and acrylic
resin-containing material with thermoplastic properties.

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1 45. The panel according to claim 40 in which the
paint coat includes a fluorinated polymer selected from
the group consisting of polyvinylidene fluoride, and
copolymers and terpolymers of vinylidene fluoride.

5 46. The panel according to claim 40 in which the
paint coat has an 80° gloss level greater than about 75
gloss units and a distinctiveness-of-image level greater
than about 80 units.

10 47. The panel according to claim 40 in which the
backing sheet is a semirigid sheet with a thickness in
the range from about 10 mils to about 40 mils.

15 48. The panel according to claim 40 in which the
backing sheet is made from a material selected from the
group consisting of ABS, polyester, amorphous nylon, and
thermoplastic polyolefins including polypropylene and
polyethylene.

20 49. The panel according to claim 40 including a
wax film applied to the outer face of the clear coat
from the casting sheet.

25 50. The panel according to claim 40 in which the
preformed laminate is molded to the substrate material
by injection cladding, reaction injection molding, or
thermoset sheet molding techniques.

30 51. The panel according to claim 40 in which a
graphics pattern is printed between the paint coat and
backing sheet to be visible through the paint coat.

35 52. The panel according to claim 40 including a
pigment contained in the backing sheet.

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53. The panel according to claim 40 including metallic flakes contained in the paint coat.

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54. The panel according to claim 40 including a water soluble protective coating on the paint coat.

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55. An exterior motor vehicle body panel comprising a plastic substrate, and a laminate on the exterior of the substrate, and a three-dimensionally thermoformed paint coat comprising a thermoplastic fluorinated polymer and acrylic resin-containing paint system that provides an exterior surface on said panel sufficient for exterior automotive use following thermoforming of said paint coat, and in which the amounts of the fluorinated polymer and acrylic resin contained in the paint system are sufficient to resist deglossing of the paint coat during the thermoforming step so that a gloss level is provided in the finished panel, together with sufficient appearance and durability properties for exterior automotive use.

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56. The panel according to claim 55 in which the fluorinated polymer is selected from the group consisting of polyvinylidene fluoride, and copolymers and terpolymers of vinylidene fluoride.

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57. The panel according to claim 55 in which the finished paint coat has a 60° gloss level greater than about 75 gloss units and a distinctiveness-of-image greater than about 80 units.

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1 58. The panel according to claim 55 in which the
paint coat has the minimum levels of gloss,
distinctiveness of image, QUV, hardness, impact
5 resistance, cleanability, acid resistance, gasoline
resistance, and abrasion resistance, substantially as
defined in the automotive specifications for exterior
automotive paint finishes described herein.

10 59. The panel according to claim 55 in which the
backing sheet is a semirigid sheet with a thickness in
the range from about 10 mils to about 40 mils.

15 60. The panel according to claim 55 in which the
backing sheet is made from a material selected from the
group consisting of ABS, polyester, amorphous nylon, and
thermoplastic polyolefins, including polypropylene and
polyethylene.

20 61. The panel according to claim 55 in which the
step of adhering the preformed laminate to the substrate
material comprises injection cladding, reaction
injection molding, or sheet molding compound techniques.

25 62. A method of manufacturing a plastic exterior
body panel for a motor vehicle having a paint coat with
exterior automotive appearance and durability
properties, the method comprising:

30 forming a laminate comprising a semirigid
synthetic resinous backing sheet having a synthetic
resinous paint coat adhered to a face of the backing
sheet by dry transfer from a casting sheet, in which an
exterior automotive gloss level is transferred to the
exterior surface of the paint coat from the casting
sheet;

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1 thermoforming the laminate into a three-dimensional shape; and

placing the formed laminate in a mold and molding a plastic substrate material to the formed laminate to bond the laminate to the substrate and form
5 a plastic car body panel with a finished paint coat;

in which the material comprising the paint coat substantially retains said gloss level during the thermoforming step; and

10 in which the backing sheet has sufficient thickness and elongation to absorb defects from the substrate material so that the finished paint coat retains said gloss level during the step of molding the laminate to the substrate panel,

15 the finished paint coat providing the appearance and durability properties sufficient for exterior automotive use.

63. The method according to claim 62 in which the
20 paint coat comprises a fluorinated polymer and acrylic resin-containing material.

64. The method according to claim 62 in which the paint coat is cast as a thermoplastic paint system
25 comprising a solution of polyvinylidene fluoride and acrylic resin.

65. The method according to claim 64 in which the paint coat has a gloss level greater than about 75 gloss
30 units and a distinctiveness-of-image level greater than about 80 units.

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1 66. The method according to claim 62 in which the
paint coat is cast as a thermoplastic paint system which
includes polyvinylidene fluoride and an acrylic resin,
and in which the polyvinylidene fluoride is dispersed in
5 a solution of the acrylic resin.

 67. The method according to claim 62 in which the
laminate is adhered to the substrate by injection
cladding, reaction injection molding, or thermoset sheet
10 molding techniques.

 68. The method according to claim 62 in which the
backing sheet is a semirigid sheet with a thickness in
the range from about 10 mils to about 40 mils.
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 69. The process according to claim 62 in which the
thermoforming step is carried out by avoiding contact
between the thermoforming apparatus and the paint coat
on the backing sheet.
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 70. A process for applying a paint coat, suitable
for exterior automotive use, to a plastic exterior body
panel of a motor vehicle, the process comprising the
steps of:
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 applying a clear coat of a solution of
vinylidene fluoride and acrylic resin in thin film form
onto a surface of a flexible casting sheet, and drying
the clear coat on the casting sheet, the surface of the
sheet having a specular reflectance for transferring to
30 the surface of the dried clear coat a gloss level
sufficient for exterior automotive use;

 casting a color coat of a pigmented solution
of vinylidene fluoride and acrylic resin in thin-film
form and drying the color coat;
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1 transferring the dried clear coat and color
coat to a semirigid backing sheet of a synthetic
resinous material to form a composite paint coat bonded
to a face of the backing sheet, in which the clear coat
5 forms the exterior surface of the transferred paint coat
and the color coat is bonded between the clear coat and
the face of the backing sheet, and in which the exterior
surface of the clear coat substantially retains the
gloss transferred to it from the casting sheet;

10 thermoforming the backing sheet and the
composite paint coat thereon to form a three-
dimensionally shaped preformed laminate; and

 adhering the preformed laminate to a synthetic
resinous substrate material to form an exterior vehicle
15 body panel;

 the clear coat substantially retaining said
gloss level during the thermoforming step; the backing
sheet having sufficient thickness and sufficient
elongation to absorb defects present in the substrate
20 material to retain an essentially defect-free gloss on
the clear coat surface following adherence of the
laminate to the substrate material; the composite paint
coat providing sufficient appearance and durability
properties for use as an exterior automotive paint coat.

25 71. The process according to claim 70 in which the
paint coat on the thermoformed laminate has a gloss
level greater than about 75 gloss units and a
distinctiveness-of-image level greater than about 80
30 units.

 72. The process according to claim 70 in which the
substrate is adhered to the laminate by injection
cladding, reaction injection molding, or sheet molding
35 compound techniques.

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73. The process according to claim 70 in which the backing sheet is a semirigid sheet with a thickness in the range from about 10 mils to about 40 mils.

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74. The process according to claim 70 in which the backing sheet is made from a material selected from the group consisting of ABS, polyester, amorphous nylon, thermoplastic polyolefins, including polypropylene and polyethylene.

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75. The process according to claim 70 in which the paint coat is cast as a solution of polyvinylidene fluoride and acrylic resin.

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76. The process according to claim 70 in which the finished paint coat has the minimum levels of gloss, distinctiveness-of-image, QUV, gasoline resistance, cleanability, acid resistance, hardness, abrasion resistance, and impact strength, substantially as defined in the automotive specifications for exterior automotive paint finishes described herein.

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77. The process according to claim 70 in which the color coat includes metallic flakes aligned linearly, and the flakes have an average thickness of less than about 2000 Angstroms.

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78. The process according to claim 77 in which the metallic flakes have a head-on brightness value greater than about 140 units.

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1 79. The process according to claim 1 in which the
color coat includes metallic flakes aligned linearly,
and the flakes have an average thickness of less than
about 2000 Angstroms.

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80. The process according to claim 79 in which the
metallic flakes have a head-on brightness value greater
than about 140 units.

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